

Sub A

What is Claimed Is:

1. A method for down-converting and de-spreading a received spread spectrum signal, comprising the steps of:
 - 3 (1) receiving the spread spectrum signal; and
 - 4 (2) sampling the received spread spectrum signal according to a control signal resulting in a de-spread baseband signal, wherein said control signal includes a spreading code corresponding to said received spread spectrum signal, and wherein pulses of said control signal include pulse widths that are established to improve energy transfer to the de-spread baseband signal.
- 1 2. The method of claim 1, wherein step (2) comprises the steps of:
 - 2 (a) sampling the received spread spectrum signal at a rate that is a sub-harmonic of the received spread spectrum signal, resulting in under-samples; and
 - 3 (b) storing said undersamples in a storage module, wherein successive undersamples form the de-spread baseband signal.
- 1 2. The method of claim 2, wherein step (a) comprises the step of operating a switch according to said control signal.
- 1 2. The method of claim 2, wherein step (b) comprises the step of charging a capacitor with said undersamples.
- 1 2. The method of claim 1, wherein step (2) comprises the step of transferring non-negligible amounts of energy from said spread spectrum to the baseband signal according to said control signal.

1 6. The method of claim 1, wherein said pulse width of said control signal is a
2 non-negligible fraction of a period associated with the received spread spectrum
3 signal.

1 7. The method of claim 1, wherein said pulse width of said control signal is
2 approximately $\frac{1}{2}$ of a period associated with said received spread spectrum signal.

1 8. The method of claim 1, wherein said spreading code is a PN code.

1 9. The method of claim 1, wherein said step (2) comprises the steps of:
2 (a) generating an oscillating signal;
3 (b) generating a spreading code;
4 (c) modulating said oscillating signal according to said spreading code,
5 resulting in a spread oscillating signal;
6 (d) triggering a pulse generator according to said spread oscillating signal,
7 wherein pulses from said pulse generator have a pulse width established to improve
8 energy transfer to the de-spread baseband signal.

1 10. The method of claim 9, wherein said step (d) comprises the step of widening
2 said pulse width by a non-negligible amount that tends away from zero time duration.

1 11. The method of claim 9, wherein said step of widening said pulse width
2 comprises approximately $\frac{1}{2}$ of a period associated with the received spread spectrum
3 signal.

1 12. The method of claim 1, wherein said spreading code is a PN code.

13. An apparatus for down-converting and de-spreading a spread spectrum signal, comprising:

(1) a spreading code generator for generating a spreading-code; and
(2) a universal frequency down-conversion (UFD) module coupled to said spreading code generator, comprising:

(a) a switch controlled by a control signal to undersample said spread spectrum signal, resulting in an undersample, wherein said control signal carries said spreading-code; and

(b) a storage device coupled to said switch to store said undersample, wherein successive under-samples form said de-spread baseband signal.

14. The apparatus of claim 13, further comprising:

a pulse generator coupled to said UFD module, comprising a means for generating said control signal having a plurality of pulses with a corresponding pulse width established to improve energy transfer from the spread spectrum signal to the de-spread baseband signal.

15. The apparatus of claim 14, wherein said storage device is one of a capacitor and an inductor.

16. An apparatus for down-converting and de-spreading a spread spectrum signal, comprising:

- (1) an oscillator for generating an oscillating signal;
- (2) a spreading code generator for generating a spreading code;
- (3) a modulator coupled to said oscillator and said spreading code generator for generating a spread oscillating signal using said oscillating signal and said spreading code;

8 (4) a pulse generator coupled to said modulator, for generating a control
9 signal using said spread oscillating signal; and

10 (5) a universal frequency translation module coupled to said pulse
11 generator, comprising:

12 (a) a switch controlled by said control signal to undersample said
13 spread spectrum signal; and

14 (b) a storage device coupled to said switch to store undersamples
15 from step (5a), wherein successive under-samples form a de-spread baseband signal.